

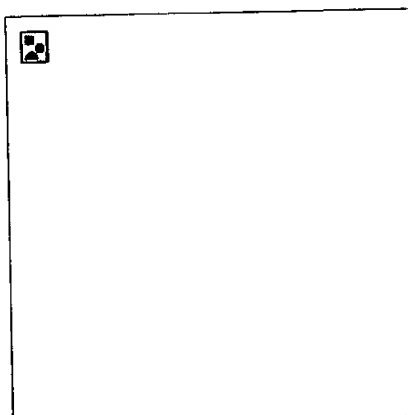
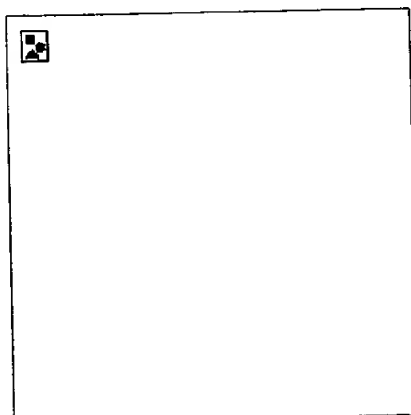
Structures With Bidentate Ligands

Bidentate ligands are Lewis bases that donate two pairs ("bi") of electrons to a metal atom.

Bidentate ligands are often referred to as *chelating ligands* ("chelate" is derived from the Greek word for "claw") because they can "grab" a metal atom in two places.

A complex that contains a chelating ligand is called a *chelate*.

Some Bidentate Ligands	
ethylenediamine (en)	acetylacetonate ion (acac)
phenanthroline (phen)	oxalate ion (ox)



● = Ni

● = C

● = N

● = H

● = Cl

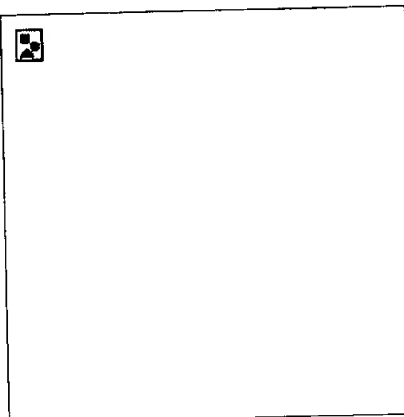
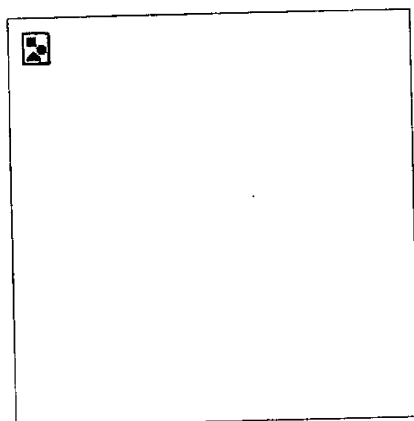
Structures With Bidentate Ligands

ethylenediammine (en)

Ethylenediammine is a neutral molecule containing two N atoms that can each donate a pair of electrons to a metal atom.

 $\text{Ni(en)}_2\text{Cl}_2$

In this complex, two ethylenediammine molecules are bonded to the Ni atom. The coordination number of 6 results in an octahedral structure.



● = Ni

● = C

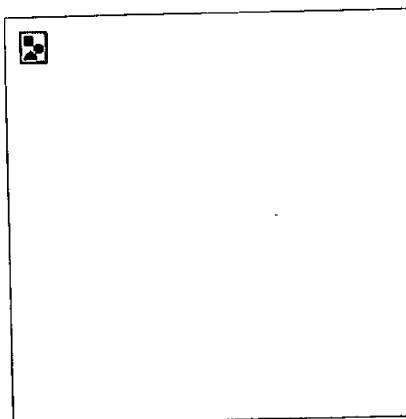
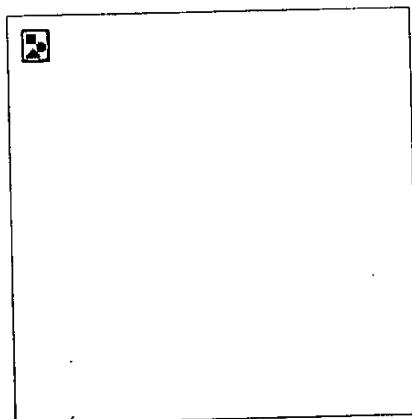
● = O

oxalate ion (ox)

Oxalate ion is a bidentate ligand even though it contains four O atoms which have lone pairs of electrons.

 $[\text{Ni(ox)}_2]^{2-}$

In this complex, two oxalate ions are bonded to the Ni atom. The coordination number of 4 results in a square planar structure.



● = Rh

● = C

● = H

● = N

● = Cl

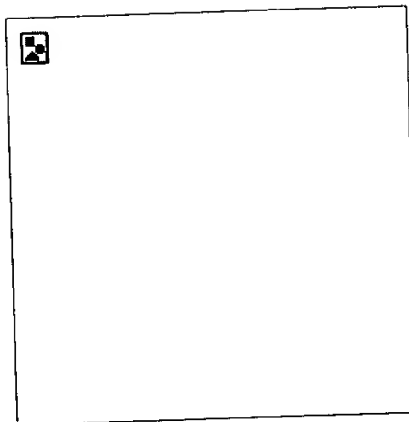
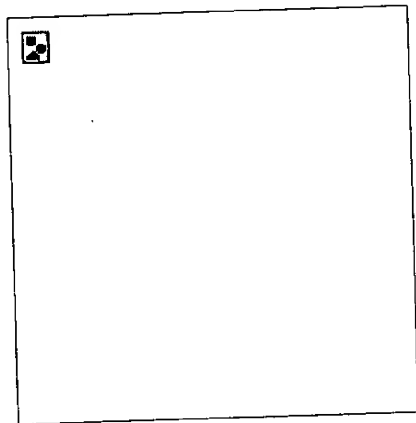
phenanthroline (phen)

Phenanthroline is a neutral molecule containing two N atoms that can each donate a pair of electrons to a metal atom.

 $[\text{Rh(phen)}_2\text{Cl}_2]^+$

In this complex, two phenanthroline molecules are bonded to the Rh atom. The coordination number of 6 results in an octahedral structure.

Structures With Bidentate Ligands



● = Cr

● = C

● = H

● = O

acetylacetonate ion (acac)

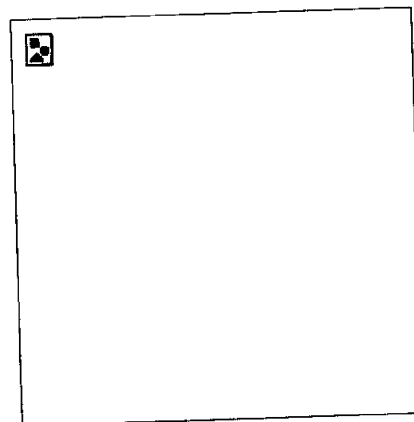
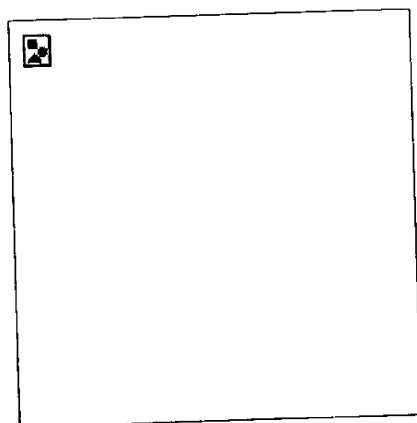
Acetylacetonate ion contains two O atoms which allow this ligand to function as a bidentate ligand.

Cr(acac)₃

In this complex, three acetylacetonate ions are bonded to the Cr atom. The coordination number of 6 results in an octahedral structure.

Applications

ZUD cleanser, which contains oxalic acid, is used to remove rust deposits. Rust reacts with oxalic acid to produce a colorless, water-soluble complex ion (i.e., $[\text{Fe}(\text{C}_2\text{O}_4)_3]^{3-}$) which contains the bidentate ligand, oxalate ion. Because the complex ion is water-soluble it can be washed away.



● = Fe

● = O

● = C

oxalate ion (ox)

Oxalate ion is a bidentate ligand even though it contains four O atoms which have lone pairs of electrons.

 $[\text{Fe}(\text{C}_2\text{O}_4)_3]^{3-}$

In this complex, three oxalate ions are bonded to the Fe atom. The coordination number of 6 results in an octahedral structure.

